Test Results of Vital Oxide

August 2009

Effect on Painted Surfaces

All test panels measured 3”x 6” and were conversion coated with Alodine 1200 prior to painting. Once coatings were cured panels were tested per ASTM F 502. Testing on painted surfaces was conducted on the following coating systems:

Deft 99GY001 over ANAC 10P20-12 (DMS 2115/DMS 2104),
PRC CA8200/D9374 over ANAC 10P20-26 (DMS 2143/DMS 2144),
ANAC 446-21-7507 over Deft 44-GN-54 (DMS 2433/DMS 1786),
Deft 44-GN-54 (DMS 1786)
PRC 833K086 (DMS 1850)

The requirement for effect on painted surfaces is the material shall not produce a decrease in paint film hardness greater than one pencil. (Some Specs say a difference of 2 pencil hardnesses is acceptable) The blue is discoloration.

Disinfectants		**7075-T6 Clad Alod 1200, Deft 99GY001over ANAC 10P20-12 (DMS 2115/DMS2104)**		**7075-T6 Clad Alod 1200 Deft 44GN54 (DMS 1786)**		**7075-T6 Clad Alod 1200, CA8200D9374 over ANAC 10P20-26 (DMS 2143/DMS 2144)**		**7075-T6 Bare Alod 1200, PRC 833K086 (DMS 1850)**		**7075-T6 Clad Alod 1200 ANAC 446-21-7507 over Deft 44GN54 (DMS 2433/DMS 1786)**	
	Pnl #	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed
Vital Oxide	1	4H	4H	4H	4H	4H	5H	4H	4H	4H	4H
	2	4H	5H	4H	4H	4H	5H	4H	4H	4H	4H

Residue Test

Residue testing was performed on 2”x6” specimens of 7075-T6 alclad aluminum and 6Al-4V titanium per ASTM F 485 as specified in AOL 10-50D. The requirement for the residue test is that the material shall leave no residue or stain. PASS

Sandwich Corrosion Test

Sandwich corrosion testing was performed on six different configurations of aluminum alloys and conversion coats per AOL 10-50D. The requirement for sandwich corrosion is that eh material shall not cause significant corrosion of aluminum faying surfaces when tested per the AOL 10-50D.

Metal	Vital Oxide
2024 bare Alodine 1500	2
2024 bare CAA	0
2024 clad Alodine 1500	1 Discoloration
2024 clad CAA	1 Slight Discoloration
7075 clad Alod 1500	1 Discoloration
7075 clad CAA	1 Slight Discoloration

Stress Crazing Test on Acrylic Plastics

Crazing test was performed per ASTM F 484 as specified in AOL 10-50D using Type C acrylic.

PASS

Immersion Corrosion Test

Immersion corrosion test was performed per ASTM F 483 as specified in AOL 10-50D using 1”x 2” 7075-T6 Al clad, 7075 bare Al, magnesium AZ31B-H24, 1020 steel, and 6Al 4V titanium test coupons. Typical requirement is no more than 10 mg per coupon.

Metal	168 hr weight difference (mg)
7075 clad Aluminum	2.40
Magnesium	4.90
4130 Steel	132.20
6Al 4V Titanium	0.17
7075 nonclad Aluminum	5.60

Cadmium Removal Test

Cadmium removal test specimens consisted of 1”x 2” 4130 steel cadmium plated. Specimens were tested per ASTM F 483 as specified in AOL 10-50D. The requirement is that the average weight loss of cadmium shall not exceed 10mg per coupon.

Disinfectant	Initial Weights (g)	24 hr Exposure Weights (g)	24 hr weight difference (mg)	Comments
Vital Oxide	11.00	11.00	-0.20	Panels turned dark gray
	10.96	10.96	0.20	
	10.91	10.91	1.40	

Hydrogen Embrittlement Test

Hydrogen embrittlement testing was conducted per ASTM F 519 as specified in AOL 10-50D using type 2A stress rings. Rings were cadmium plated, stressed with the 2.415” stress bars and immersed in cleaning solution for 168 hours.

One of three rings fractured but did not crack; PASS

Immersion Corrosion B

Testing for immersion corrosion B was performed per ASTM F 483 except test duration was 30 minutes instead of 168 hours, and test temperature was 135°F instead of 100°F. Materials tested under these parameters included nickel (AMS 5536), stainless steel (UNS S4100), 1020 steel, 4130 cadmium plated steel, Sermatel W coated steel, and 6Al-4V titanium. No Failures noted.

Metal	30 minute weight difference (mg)
Stainless Steel UNS 4100	0.47
6Al 4V Titanium	0.27
1020 Steel	25.17
Nickel AMS 5536	0.73
Cadmium Plated 4130 Steel	0.07
Sermatel W Coated 4130 Steel	-0.30

The remainder of the tests were performed to determine if the disinfectant had any affect on the integrity of the materials being evaluated. No specific pass/fail criteria are provided.

Adhesives

Shear strength testing was performed on the adhesives to determine effects of the disinfectants. Shear specimens used for bonding consisted of 2024-T3 bare Al that was solvent cleaned and FPL etched prior to bonding. Hysol EA 9309 specimens were primed with AC 131 before applying adhesive, and 3M AF 163-2M adhesive film specimens were primed with Scotchweld EC 2934 B primer prior to applying adhesive. Test specimens were immersed in disinfectants for 96 hours and then tested per ASTM D 1002.

Material	Fluid	LOAD	Shear Stress	Percent Change Relative to Control (Shear)
		(lbs)	(psi)	
Hysol EA9309	Vital Oxide	2425	4930	-8.74%
3M AF 163	Vital Oxide	1629	3272	-20.16%

Elastomers

Silastic J was tested per ASTM D 471. Properties that were tested included percent elongation, tensile strength, hardness and change in volume.

When preparing the 6” x 6” x 0.08” test slabs per ASTM D 471, the GE RTV 159 material would not cure properly. The material cures in an ambient environment using moisture from the air. Material inside the test slab mold was not exposed to enough moisture for material to cure properly. In order to keep project testing going, tensile strength and elongation testing was replaced with lap shear testing. Lap shear specimens consisted of 2024-T3 bare aluminum solvent cleaned and then FPL etched prior to bonding using the GE RTV 159. Hardness and

change in volume was also performed on GE RTV 159. All elastomeric test specimens were immersed in disinfectants for 96 hours prior to testing.

Material	Fluid	LOAD	Shear Stress	Extension	Elonga-tion	Percent Change Relative to Control Elongation[1] Shear[2]	Change in volume %	Hardness of Silastic J after Exposure			
		(lbs)	(psi)	(in.)	(%)			24 Hr	48 Hr	72 Hr	96 Hr
Silastic J	Vital Oxide	17	714	2	237	-13.82%	0.098	56	57	56	56
RTV 162	Vital Oxide	303	607	-	-	29.70%	0.64	35	35	35	35

1 for Silastic J
2 for RTV 159

Wet Tape Adhesion - Adhesion testing was performed per BSS 7225 using a 90 degree crosshatch scribe. Coatings that were tested included Deft 44-GN-54 (DMS 1786) and ANAC 10P20-12 (DMS 2104). The 3" x 6" coated test panels were submerged half way in the cleaning solutions for 24 hours and tested upon removal. A Rating of 7 is typically used for pass/fail criteria.

Cleaner	DMS 1786 / Deft 44-GN-54					
	Dry			Immersed		
	1	2	3	1	2	3
Vital Oxide	10	10	10	10	10	10
Cleaner	DMS 2104 / ANAC 10P20-12					
	Dry			Immersed		
	1	2	3	1	2	3
Vital Oxide	10	10	10	9	9	9

Panels discolored after immersion

Sealants

Sealant hardness was tested per ASTM D 2240 on 1" x 2" test specimens. Sealant shear strength was tested per ASTM D 1002. Shear strength specimens were tested using 2024-T3 bare aluminum that was solvent cleaned and FPL etched prior to bonding. Test specimens were immersed in disinfectants for a 96 hour period prior to testing.

Material	Fluid	LOAD	Shear Stress	Percent Change Relative to Control Shear
		(lbs)	(psi)	
PR1750	Vital Oxide	260	520	-12.16%
PR 1422	Vital Oxide	276	552	-9.21%
PR 1828	Vital Oxide	143	286	-36.44%

Wire Insulation

First test performed on wires was Method 601, Fluid Immersion, per SAE AS 4373. Wires were immersed for 20 hours at 118°F with a bend radius of 1 inch. After removal from disinfectants, wires were dried and allowed to sit at ambient conditions for one hour. After one hour, wires were subjected to bend test. Wire types Mil-W-22759/11-20-9 white, and MIL-W-81381/11-2019-N (natural) were tested with a 0.25" diameter mandrel, and test load of 0.75 lbs. MIL-W-22759/86-20-5 green, was tested with a 0.5" diameter mandrel and test load of 1.5 lbs. After performing bend test, voltage withstand was performed per Method 510 of SAE AS 4373.

The requirement states that the radius of the wire shall be not less than 14 nor more than 35 times the specified diameter of the wire under test. It was also tested to the wet dielectric test. All test candidates performed well with the wire testing. All wire types saw no failures with wire swelling, bend, and wet dielectric testing.

PASS

Titanium Stress Corrosion

Titanium stress corrosion testing was carried out per ASTM F 945, Method B. The requirement is that the specimens do not crack. All titanium stress corrosion coupons showed no cracking upon visual inspection when removed from the oven. Upon further metallographic examination at 500X no cracks were discovered.

Seat Belts

Seat belt breaking strength and elongation were tested per ASTM D 5035. Test specimens had to be cut from 2" x 6" to 1" x 6" strips because 2" width specimens were too strong for testing apparatus. Seat belt test specimens were immersed in disinfectants for 96 hours prior to testing.

Cleaner	LOAD	Shear Stress	% Elongation	Percent Change Relative to Control Shear	Percent Change Relative to Control Elongation
Vital Oxide	1475	20	63	-16.67%	0.00%